Farmers' Bulletin No. 1985

SEED for REGRASSING GREAT PLAINS AREAS

U. S. DEPARTMENT OF AGRICULTURE

Range and pasture grass seed, now needed on farms of the United States as never before, can be grown successfully as a farm crop. To produce the forage grass seed he needs and often cannot buy, the farmer needs skill and judgment. In addition he needs special information as to what kinds of grass will best control erosion and produce forage on such soil as his and under the local conditions as to climate; how to tell whether a seed crop is worth harvesting and when it is ready for harvest; what machinery and methods should be used in harvesting the seed; and how the seed should be cleaned and processed. Helpful information on these points is offered here to farmers of the Great Plains and adjacent prairie areas.

This bulletin supersedes Farmers' Bulletin No. 1812, Native and Adapted Grasses for Conservation in the Great Plains and Western States.

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SEED FOR REGRASSING GREAT PLAINS AREAS

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INTRODUCTION

Probably no crops grown in the United States have more conservation uses or more all-around value than the grasses. Wherever they are grown, grasses protect land from wind and water erosion and maintain or improve soil quality, in addition to producing pasture and hay. As a result, more acres are being seeded to grass and more species of grass are being grown in the United States now than ever before. Grasses are being seeded to restore badly eroded land to useful production, to heal gullies, to prevent damage by runoff water on steep slopes, and to line waterways so that excess water from cultivated fields can be disposed of without erosion.

Each grass species has characteristics that suit it better for some purposes than for others. Some form sod and are well suited for use in waterways. Some grow in bunches, and bind the soil in place with their roots alone. Root systems differ widely. Some species grow in spring and fall, others in summer; use of both these kinds together lengthens the pasture season.

The recent great increase in use of grasses has given a boost to the harvest of grass seed, but supplies are still too small in most cases. Needs are certain to grow still greater. In addition to the normal demand arising from the continued spread of conservation farming, much grass seeding is needed as a direct result of the war. Many thousands of acres of cropland need a rest after 4 years of war production. Other thousands of acres were brought into cultivation for the first time during the emergency and will go back to grass.

It is necessary, therefore, for more farmers and ranchers to harvest their own grass seed. Many farmers and soil conservation district supervisors have demonstrated that this is practical. Methods and necessary adjustments of regular farm machinery have been worked out by the Soil Conservation Service and State experiment stations in cooperation with farmers. It is now possible to give reliable information about judging of seed crops and methods of harvesting for the introduced species and most of the native species of forage grass.

Production, harvesting, and processing of grass seed are not simple operations. They require at least as much skill as the same steps in management of cereal and other farm crops. In particular, very careful attention must be given to selecting areas suitable for seed production, determining seed fill, selecting and adjusting harvesting equipment, and timing harvesting operations. Skill growing out of experience in each of these things often means the difference between a farmer's success and failure in seed production.

The region for which this bulletin has been prepared includes the Great Plains and adjacent prairie areas of eastern North and South Dakota, Nebraska, Kansas, Oklahoma, and Texas. It includes about

30 percent of the total land area of the United States. Because of the climate, with limited and irregular rainfall, grass has a greater part in agriculture here than elsewhere in the United States. Production of livestock is and should continue to be a leading industry in this region.

This bulletin is intended to help farmers, ranchers, and technicians in efforts to establish suitable native and introduced grasses. It gives characteristics of various species with regard to erosion control and forage production and information made available by 10 years' experience in the region in harvesting and processing grass seed.

ADAPTATION OF GRASSES

Native and introduced forage grasses of the Great Plains and adjacent prairie areas are adapted to wide ranges of conditions as to soil and climate. Many different grasses are available for conservation use in any area or on any farm of the region. However, individual grasses of the region have different needs. Not all of them do well on soil of only moderate fertility. Some are adapted to low-rainfall conditions and do poorly where moisture is plentiful; others require large supplies of moisture. Species and strains brought from the northern to the southern part of the region are likely to prove unsuited to southern conditions, and some of those suited to the southern part cannot stand the cold of the northern part. Similarly when grass seed is planted at an elevation higher or lower than that at which it originated or is moved from the eastern to the western part of the region or vice versa, plants grown from it often do not make satisfactory growth and sometimes cannot survive. It is strongly recommended that anyone undertaking to regrass an area in the region use seed of known local origin or of a species or strain known to be adapted to the locality. This is another reason why farmers and ranchers should produce and collect their own grass seed.

The only way to learn whether a certain grass seed collection will give good results in a locality other than that where it originated is to make careful test plantings. State agricultural experiment stations and other research agencies have established cooperative field plantings to test the suitability of given species and varieties. Their recommendations serve as a guide to the farmer in choosing grasses for conservation plantings.

An example of the useful results of research with forage grasses in this region is what has been learned about the adaptation of different strains of smooth brome (*Bromus inermis*). Smooth brome was introduced into the Great Plains from Russia and also from Hungary. When test plantings were made in the central part of the region with seeds of the Russian strains, the plants did not produce well and did not thrive during the long periods of dry, hot summer weather. However, when seeds of the Hungarian strains were planted there they produced vigorous plants that continued to thrive during the summer. In the northern part of the region, the Russian strains proved to be at least as well adapted as the Hungarian strains.

Blue grama (*Bouteloua gracilis*) grows naturally from North Dakota to central Texas. Within this range, blue grama seeds from widely scattered locations were planted to determine the forage yield of different stocks and their adaptation to soils and climatic condi-

tions. Blue grama from Texas seed planted in North Dakota continued to grow during cool fall weather but did not set seed before killing frost. Many of the plants, also, could not stand the low winter temperatures of North Dakota. On the other hand, blue grama grown in central Texas from North Dakota seed bloomed and set seed early in the summer and did not continue growth through the whole of the growing season.

IMPROVEMENT OF GRASS STRAINS

The grasses native to the region discussed here and those introduced into it from different parts of the world form a vast array of plant materials from which new improved strains of forage crops may be developed. Improvements sought through plant-breeding research include greater yields of forage and seed, increased erosion-control value, greater resistance to disease and insects, better growth characteristics, and capacity to produce well under special combinations of soil and climatic conditions.

When a plant breeder produces a new grass strain having desired characteristics, it becomes valuable to farmers only after being carefully tested under field conditions. Tests to determine the value of the new strain are made cooperatively by Federal and State agricultural research agencies.

When a superior selection of a grass has been developed, the next step is to provide seed for distribution to farmers. The research agencies that have tested the strain and recommended it usually supply seed of it to certified seed growers, who increase the seed for distribution to the public. Foundation seed blocks are maintained by the research agencies, to ensure a continuing source of high-quality seed.

CHARACTERISTICS, DISTRIBUTION, AND SEED-CROP MANAGEMENT OF GRASSES

In this section, information is offered that will guide any farmer of the Great Plains or an adjacent prairie area in selecting grasses suitable for conservation use on his land and help him to produce seed of these grasses. For each of the principal grasses discussed, areas of major and minor distribution are mapped. The chance of successfully producing the grass is good within the area of minor distribution, but is better within the area of major distribution.

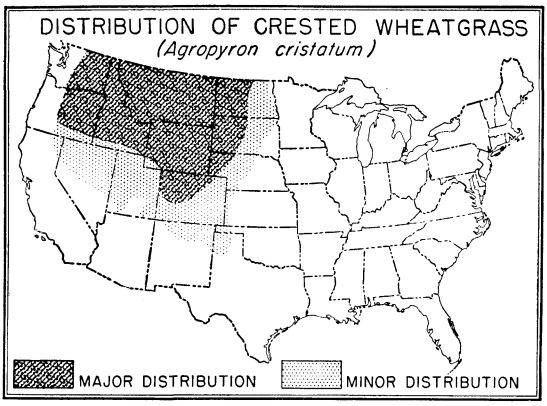
WHEATGRASSES

Wheatgrasses (*Agropyron* spp.) grow well in the soil and climate of the northern Great Plains, and their seeds can be bought from dealers. Once they become established, wheatgrasses persist, produce good ground cover, and effectively bind the soil. They provide large amounts of forage palatable to all classes of livestock. They also add much organic matter to the soil.

Crested Wheatgrass

Crested wheatgrass (*Agropyron cristatum*) is a vigorous perennial bunchgrass with a deep and extensive fibrous root system. Introduced from Russia by the Department of Agriculture in 1898, it has proved well adapted to the northern Great Plains. It is winter hardy and

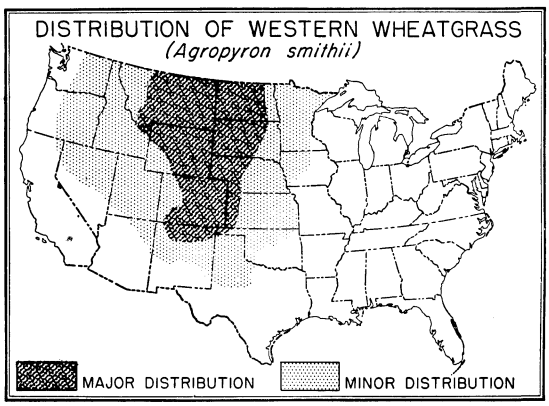
very drought-resistant, and tolerates wide ranges of temperature, moisture, and soils. An outstanding virtue is its capacity to produce abundant forage in spring, the season when green forage to supplement native pasture or range is most needed. It is dormant in summer, but makes further growth during the fall if enough moisture is available. Good yields of high-quality hay can be obtained by cutting the grass before its seed heads are fully developed.



Most of the crested wheatgrass grown in the United States is of the Standard strain. Plants of this strain vary considerably in leafiness, type of head, and characteristics of stem. Some of them produce awnless seed; others produce seed having objectionable awns. The Fairway strain, originated in Canada, is used in the United States to some extent. In general Fairway seedlings and plants are smaller than those of the Standard strain, the seeds are smaller and are definitely awned, and the plants are usually more leafy.

Crested wheatgrass is one of the best grasses to use in revegetating areas in the northern Plains where rainfall is scanty. New stands are fairly easy to establish with seeding equipment and methods commonly available to farmers. The seed germinate readily and produce vigorous seedlings, which compete successfully with weeds. Even if the first year's results do not appear successful, usually a good stand develops in the second or third year after seeding.

Good yields of crested wheatgrass seed depend chiefly upon rainfall during the spring months, reserve soil moisture, soil fertility, and vigor and age of stand. Moderate grazing or mowing of old growth improves seed yields. Seed of higher quality and more consistent yields can usually be obtained by seeding the grass in rows and cultivating it. Seed yields of grass grown in rows and cultivated commonly range from 200 to 300 pounds per acre. A pound of pure seed normally contains 165,000 to 200,000 seeds.



Crested wheatgrass seed is ready to harvest during late June in the central Plains and usually a month later in the northern Plains. Because the grass normally grows more than 2 feet tall, it can be combined directly or harvested with a binder or header or with a swather and a pickup-attachment combine. Ordinary grain threshers and fanning mills may be used to thresh and clean the seed. As seed comes from the combine or thresher, it normally has an average purity of 65 percent and an average germination of 88 percent. Recleaned seed should have a purity of 94 percent.

Western Wheatgrass

Western wheatgrass (*Agropyron smithii*), known also as bluestem wheatgrass, is a native perennial sod-forming grass. It has deep fibrous roots and vigorous underground stems that effectively protect the soil from wind and water erosion. This grass occurs most abundantly in the northern and central Great Plains. It is common also in the southern part of the region, particularly on heavy soils where runoff water accumulates. Where soil is favorable and moisture plentiful, western wheatgrass may be found in almost pure stands. On upland sites, however, it commonly occurs together with grama grasses (*Bouteloua* spp.) and needlegrasses (*Stipa* spp.). On abandoned cropland in the northern Plains it frequently volunteers together with feather bunchgrass (*Stipa viridula*).

Western wheatgrass starts growth early in the spring, and produces high-protein spring growth that is especially relished by livestock. Plants reach a height of 2 to 3 feet by midsummer. The grass is dormant during the dry summer months, but makes further growth in early fall if enough moisture is available. The forage produced in the fall is readily eaten by livestock. In years of heavy growth, forage remaining in the fall may be either cut and stored as hay or allowed to stand. If left standing, it cures well and is useful for winter grazing.

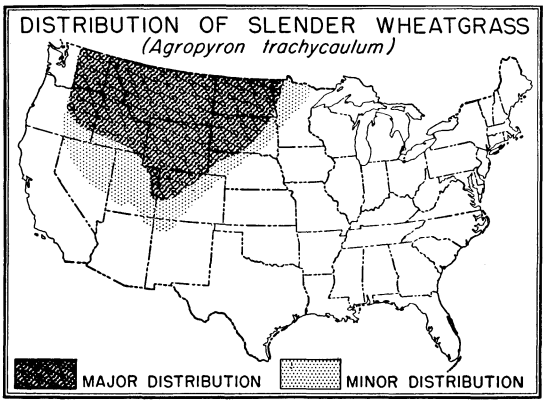
Western wheatgrass is rather slow to germinate and become established. This drawback is in some degree offset by the fact that established plants spread by underground stems. Partly because of slow establishment, this grass should be seeded in mixtures rather than alone.

Good seed crops do not occur regularly, largely because of variable climate. Hot drying winds during the blooming stage may limit the setting of seed. Old stands of western wheatgrass, as of all other sod-forming grasses, may become sod-bound and therefore produce little forage or seed. Tillage with a disk, cultivator, or other sharp-edged implement often renovates a sod-bound stand. Yield of good-quality seed from a heavy natural stand has sometimes averaged 150 to 200 pounds per acre.

Seed harvest usually begins about August 1 in the northern part of the region and somewhat earlier in the southern part. A good stand of western wheatgrass resembles a field of wheat. Its seed may be combined directly or harvested with a binder or header or with a swather and a pickup-attachment combine. Seed from the combine or thresher, after being cleaned with a fanning mill, should have a purity of 88 percent and a germination of 80 percent. A pound of pure seed contains 100,000 to 125,000 seeds.

Slender Wheatgrass

Slender wheatgrass (*Agropyron trachycaulum*) is a native perennial grown extensively throughout the northern Great Plains. It is winter hardy and moderately drought-resistant, but has a rather shallow root system and is short-lived. It is especially adapted to shallow soils of low fertility. It starts growth early in the spring, produces vigorous, fast-growing seedlings, and usually reaches a height of 2 to 3 feet at maturity. The forage is relished by all classes of livestock.



Slender wheatgrass has excellent qualities for erosion control. It is well suited for seeding in mixtures with species that are slow to become established.

With normal rainfall, this grass seldom fails to produce a satisfactory seed crop. It produces higher seed yields when planted in rows and cultivated.

Seed harvest usually starts about August 1 in the northern part of the region, and earlier to the south. Yields of 200 to 300 pounds per acre are normal. The seed may be combined directly or harvested with a binder or header or with a swather and a pickup combine. After cleaning with an ordinary fanning mill, it should have 95-percent purity and 92-percent germination. A pound of pure seed contains 140,000 to 160,000 seeds.

BLUESTEMS

The bluestems (*Andropogon* spp.) are native prairie grasses adapted to high-rainfall areas of the Great Plains. Together with other native species, they cover much of the land in the region that has been used continuously for grazing. They are highly valued for erosion control. Being summer-growing grasses, they fit well into a grazing rotation scheme with cool-season grasses.

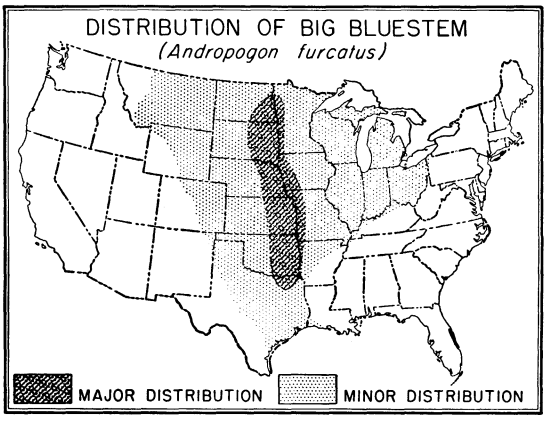
Big Bluestem

Big bluestem (*Andropogon furcatus*) is a native grass having strong, deep roots and short underground stems. It produces a sod highly resistant to erosion. It occurs with other prairie species in the eastern part of the Great Plains, where moisture conditions are most favorable. Growth starts in late spring and continues all summer. The grass often reaches heights of more than 6 feet at maturity. The leafy forage is highly palatable to all classes of livestock. It makes good-quality hay if mowed before it becomes stemmy and seed heads form.

Big bluestem, even if seeded alone, gives the soil excellent protection against erosion. Usually it is seeded in mixture with species with

which it grows naturally. Perhaps its most important use is to retire cropland to meadows and pastures. It builds up the organic content of the soil rapidly, through decay of roots and tops.

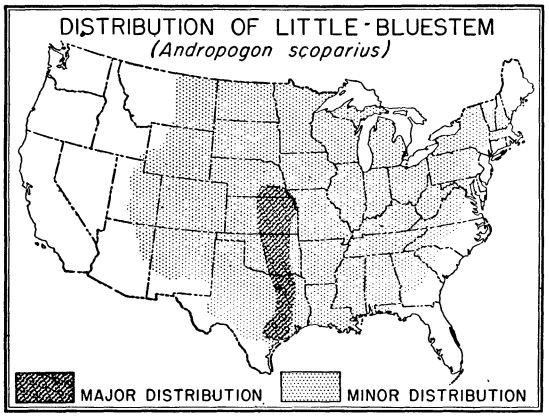
Few fields of big bluestem produce seed every year. This is because the combination of plentiful moisture and moderate temperatures does not occur regularly. When grown in rows and cultivated, however, this grass regularly produces from 150 to 200 pounds of seed per acre. The seed normally matures in late September or October.



Stands of big bluestem should be examined with great care before seed harvest to determine the set of seed. Under best conditions a seed fill seldom exceeds 50 percent. A fill of 20 percent usually justifies harvesting the seed. The seed has been harvested satisfactorily with ordinary binders and with small-grain combines. Combine- or thresher-run seed material of this grass, when processed with a hammer mill and cleaned with a fanning mill, should have a purity of at least 40 percent and a germination of about 60 percent. A pound of pure seed contains 140,000 to 170,000 seeds.

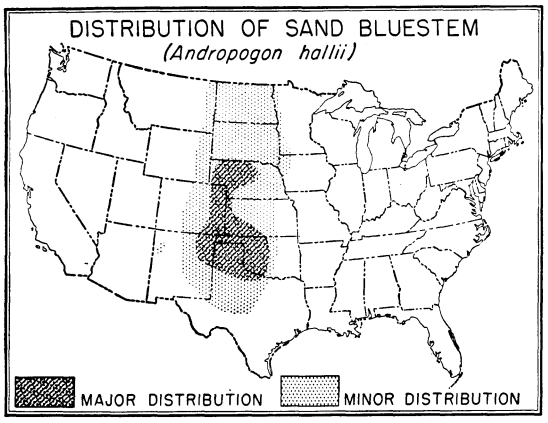
Little Bluestem

Little bluestem (*Andropogon scoparius*) is a native bunchgrass with a deep fibrous root system. It grows naturally under the conditions required by big bluestem, but is well adapted also to poor, droughty sites. Hence it is found on gravelly soils, on ridges, and in other exposed locations. One of the main areas where it grows naturally is the flint hill section of east-central Kansas and Oklahoma. Its range includes the whole of the region discussed here. Growth of this grass starts late in the spring and continues all summer. Plants reach a height of 2 to 4 feet, and produce good-quality hay if mowed before seed heads are fully developed.



Because of its habit of growth and the wide range of soils on which it thrives, little bluestem has great merit for erosion control. It is suitable for use in crop rotations and also in mixtures for regrassing abandoned cultivated land.

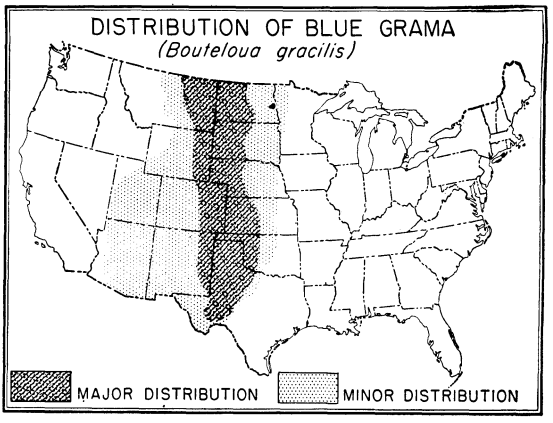
Timely summer rainfall, reserve moisture, and favorable temperatures at blooming time are needed for seed development. It is seldom that any area not under cultivation produces a seed crop 2 years in succession. The seed matures in late September or October in Nebraska and to the south, and just before frost farther north. A seed fill of 70 percent is considered excellent; one of 30 percent is satisfactory for harvesting. When grown in rows and cultivated, little bluestem has sometimes yielded 200 to 300 pounds of seed per acre.



Little bluestem seed is harvested successfully by direct combining and also with a binder or with a swather and a pickup combine. Threshing, processing with a hammer mill, and cleaning with a fanning mill should result in seed purity of 40 percent or more and germination of 60 percent. A pound of pure seed contains 254,000 to 263,000 seeds.

Sand Bluestem

Sand bluestem (*Andropogon hallii*) is a vigorous perennial sod-forming grass with a deep fibrous root system and aggressive underground stems. A single plant sometimes forms a dense colony as large as 30 feet in diameter. This species is native to the southern and western parts of the region. It can survive prolonged drought, and is primarily adapted to the region's deep sandy soils. It has value for erosion control on such soils.



Growth begins rather early in the spring in the southern part of the region and from 2 to 3 weeks later than that of cool-season grasses in the northern part, and continues at a rapid rate throughout the summer. Plants generally reach a height

of 5 to 7 feet. If cut before seed heads form, sand bluestem produces good-quality hay.

The seed matures in late September or October. Under ordinary field conditions, a fill of 60 percent is considered excellent. Harvest should not be undertaken if seed fill does not amount to 20 percent.

The best method of seed harvest is to combine direct in the field. Binding is satisfactory. Seed yields from native stands seldom exceed 30 to 50 pounds per acre. Yields from plants grown in rows under cultivation have ranged from 100 to 200 pounds per acre. When recleaned, the seed should have a purity of 40 percent or more and a germination of about 60 percent. A pound of pure seed contains 105,000 to 122,000 seeds.

GRAMAS

Gramas (*Bouteloua* spp.) grow naturally throughout the greater part of the region and are reliable producers of good-quality forage on range and pasture land. They rank very high for conservation use; they are adapted to many kinds of soil and of natural moisture conditions, can withstand drought, and are capable of holding erodible soils once they become well established. These species are known as warm-season grasses. They start growth in the spring about 2 to 3 weeks later than cool-season grasses.

The gramas have been seeded successfully by many farmers in the Great Plains. Seed supplies have not been adequate, but improved methods of harvest are increasing them. Small-grain harvesting equipment is used.

Blue Grama

Blue grama (*Bouteloua gracilis*) is a native perennial bunchgrass that grows generally with buffalo grass (*Buchloë dactyloides*) and, in the northern parts of the region, with wheatgrasses and *Stipa* species also. A typical short grass, it seldom grows taller than 12 to 20 inches. It is adapted to wide ranges of soil and climate, and produces highly nutritious forage during the summer. Forage remaining in the fall makes good winter pasture if allowed to cure standing.

Blue grama is readily established from seed. New stands established by solid seeding have given excellent forage yields. This is one of the most dependable native grasses for conservation use.

The amount of seed produced depends on whether moisture is plentiful and temperatures are cool at the time of blossoming and seed formation. Because blue grama grows naturally in extensive stands, almost all the seed used for planting has been collected from such natural stands. It is expected that natural stands will continue to be the source of nearly all the seed collected.

The seed usually matures sometime after early August. It ripens rapidly as it nears maturity, and after it becomes mature the seed heads shatter readily. Under field conditions seed heads may contain from 0 to 75 percent fertile seed. To be satisfactory for harvesting, a stand must have 25 percent or more filled seed.

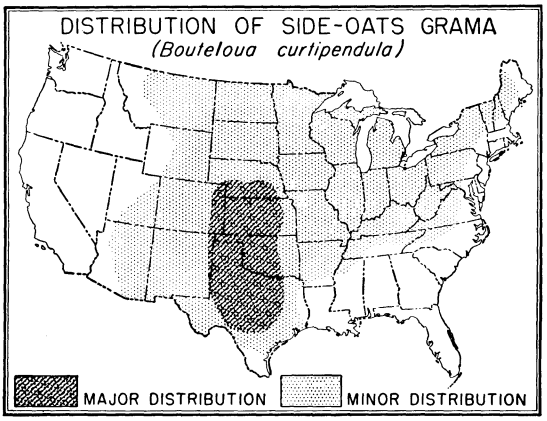
Direct combining is an effective method of seed harvest. Swathing followed by pickup combining has given somewhat higher yields. Seed yields of 100 to 180 pounds per acre have been obtained. The

seeds are light, and the combine- or thresher-run seed material contains considerable amounts of straw and chaff. Therefore it is desirable to clean the seed with a scalper screen or fanning mill for farm use. For most efficient seeding with an ordinary grain drill, it may be necessary to process the seed with a hammer mill.

Seed cleaned in a fanning mill should have a purity of at least 40 percent and a germination of 75 percent. A pound of pure seed contains 800,000 to 825,000 seeds.

Side-Oats Grama

Side-oats grama (*Bouteloua curtipendula*) is a native perennial grass having an extensive fibrous root system. It is winter hardy and drought-resistant and is adapted to a wide range of soil and climatic conditions. It is found in mixture with blue grama, buffalo grass, and little bluestem. It predominates in this mixture on shallow soils, steeply sloping lands, deep sand, and exposed sites. Although side-oats grama has short underground stems, it seldom forms a dense sod under the conditions as to soil and climate existing where it is most common.



Side-oats grama produces leafy forage that is palatable to all classes of livestock. Good-quality hay may be produced if mowing is done at the right stage of growth. This grass ranks very high for conservation use, owing to the vigor of its seedlings and the ease with which it is established on severely eroded soils. Ordinarily it is seeded in mixtures with other native species with which it occurs naturally. Growth begins in the spring and continues through the summer. Mature plants normally reach a height of 2 to 3 feet.

Seed matures sometime after midsummer. The percentage of filled seed, under field conditions, ranges from 0 to 40. Stands having a seed set of less than 10 percent should not be harvested.

The seed is successfully harvested either by direct combining, by binding, or by windrowing plus pickup combining. Yields commonly range from 100 to 400 pounds per acre. The higher yields come from row plantings on fertile soil well supplied with moisture. The seeds tend to remain in clusters unless separated mechanically.

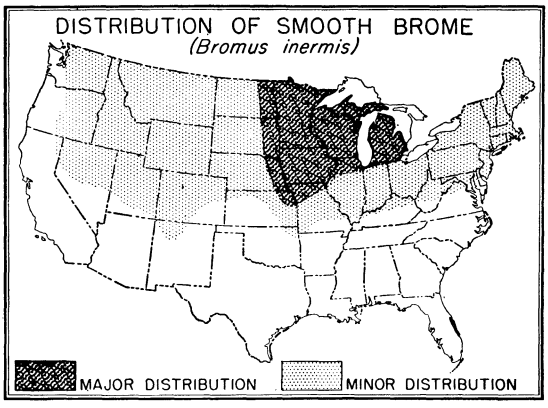
After removal of excess straw and chaff by means of a scalper screen or fanning mill, the combine- or thresher-run seed should have a purity of 30 percent and a germination of 65 percent. A pound of pure seed contains about 125,000 seed clusters or about 500,000 seeds.

SMOOTH BROME

Smooth brome (*Bromus inermis*) is an aggressive sod-forming perennial grass introduced from Europe. It is now grown exten-

sively in eastern parts of the region discussed here and is grown to some extent under irrigation in western parts. It is winter hardy and moderately drought-resistant. In the localities to which it is adapted, no grass excels it in resisting erosion. Smooth brome stands are maintained more satisfactorily if a legume, particularly alfalfa, is grown in mixture with the grass. A legume is desirable because of the part it plays in addition of nitrogen to the soil; also, it lessens the tendency of the stand to become sod-bound. Brome is favored by deep, fertile soil, moderate rainfall, and mild summer temperatures. Its range has been increased by selection and development of locally adapted strains. Consequently, source of seed greatly affects the chance of success in producing this grass.

Growth begins in early spring and continues until checked by shortage of moisture or of available nitrogen. Plants grow to heights of 3 to 4 feet. The leafy vegetation is relished by all classes of livestock. If mowed and cured at the proper stage, it makes very good hay.



Stands continue to produce seed for many years, as long as the plants remain thrifty. Sod-bound stands can usually be improved by applying nitrogen fertilizers and renovated by tillage with a disk or cultivator, particularly in areas having a rainfall of 20 inches or more.

The seed matures in midsummer. Under normal conditions, about 75 percent of the seed units are well filled. Stands with 50-percent seed fill are satisfactory for seed harvest.

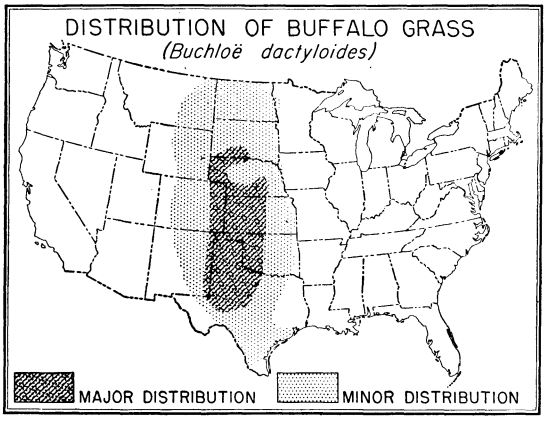
Binders and combines have been used successfully for harvesting seed of smooth brome. Yields of 300 to 500 pounds per acre are reported. If the grass is grown in rows on fertile soil and cultivated, yields may be still greater. Combine- or thresher-run seed, if cleaned with a fanning mill, should have a purity of 85 percent and a germination of 90 percent. A pound of pure seed contains 170,000 to 200,000 seeds.

BUFFALO GRASS

Buffalo grass (*Buchloë dactyloides*), a native deeply rooted perennial, is a typical short grass. It occurs commonly—usually in association with blue grama—in the central and southern Great Plains, particularly in western Kansas, eastern Colorado, and the high plains of Texas. It grows more abundantly on heavy than on sandy soils. This grass spreads rapidly by means of surface runners and forms a dense, matted growth 5 to 8 inches high. Usually the same plant does not produce both pollen and seed.

Growth begins in late spring and continues all summer. The forage is attractive to all classes of livestock. Buffalo grass becomes estab-

lished rather easily, and spreads vigorously under use. It withstands prolonged heavy grazing better than any other grass native to the region; on ranges severely grazed every year, it often survives as a nearly pure stand. It is ideally suited for erosion control on range and pasture land where the soil does not contain too much sand.

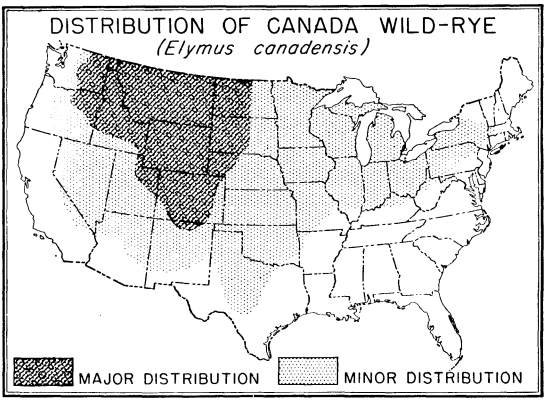


Buffalo grass seed is enclosed in hard burs, one or several grains to a bur. The stems of the burs are no taller than the leaf growth. When moisture is abundant the burs are produced continuously from midsummer until frost. No seed is produced when soil moisture is low. The burs normally have a low germination. Usually they must be treated to ensure good stands from planting at moderate rates.

Small-grain combines altered so that the sickle can be run very close to the ground have generally proved satisfactory in harvesting buffalo grass seed from ungrazed stands. Suction machines, brooms, or beater equipment must be used to collect the seed from closely grazed stands. Natural stands have yielded 20 to 100 pounds of clean burs per acre. After being cleaned in an ordinary fanning mill, the burs should have a purity of 95 percent or better. Clean burs average 40,000 to 55,000 per pound.

CANADA WILD-RYE

Canada wild-rye (*Elymus canadensis*) is a native perennial bunchgrass. Of the several species of wild-rye that grow on the Great Plains it has the greatest value, both for conservation and for forage production. It is winter hardy and grows well on many kinds of soil. It is especially well adapted to sandy soils. The seedlings are very vigorous; therefore new plantings can be established quickly. This makes Canada wild-rye very useful in mixtures with other grasses, especially with those that do not produce ground cover rapidly.



This grass begins growth about a week later in the spring than smooth brome or crested wheatgrass. It usually continues to grow

all summer if moisture conditions are favorable, and may make further growth in the fall if enough moisture is available then. It produces exceptionally high yields of forage, which is palatable to all classes of livestock. Hay of good quality may be obtained if the wild-rye is harvested just as the seed heads are emerging from the boot.

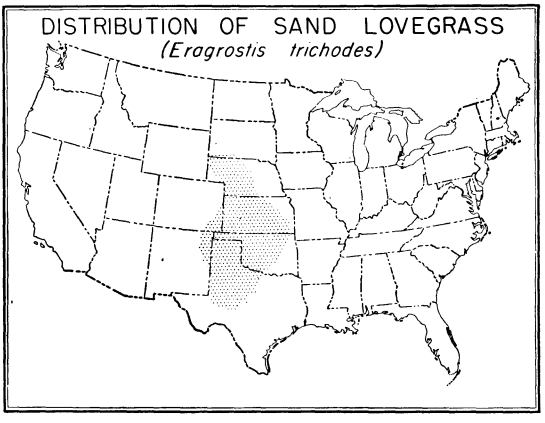
The seed matures in late summer. Seed heads should be examined very carefully before harvest to determine seed fill. This may vary from 40 to 90 percent, depending upon moisture conditions, soil fertility, and temperature during the period of blooming and seed development. Fields having less than 50 percent seed fill are not satisfactory for seed harvest.

Seed of Canada wild-rye is harvested most satisfactorily with a binder. A combine may be used if it has proper screens. This species produces abundant seed; yields of 300 to 400 pounds per acre from native stands are common. If the grass is grown in rows and cultivated, seed yields average considerably higher.

Combine- or thresher-run seed should have an average purity of 65 percent and a germination of 90 percent. Cleaning with an ordinary fanning mill after removal of the awns should result in a seed purity of at least 90 percent. A pound of processed pure seed contains 110,000 to 120,000 seeds.

SAND LOVEGRASS

Sand lovegrass (*Eragrostis trichodes*) is an important forage species of the central and southern Great Plains, where it is native to most of the sandy land areas. It is an erect, vigorous bunchgrass that begins growth very early in the spring and remains green until late fall. Plants usually reach a height of about 3 feet at maturity.



Sand lovegrass is easily established by seeding, and volunteers aggressively. Excellent results are obtained by seeding it alone or in mixtures on sandy soils. On heavy soils, it does not thrive except in pure stands.

Natural stands of sand lovegrass are seldom suitable for seed harvest, because of the presence of brushy plants such as sand sage (*Artemisia filifolia*), shinnery oak (*Quercus* spp.), or skunkbrush (*Rhus trilobata*). This grass produces good seed yields under cultivation. Yields have exceeded 150 pounds per acre on dry land and 400 pounds per acre under irrigation.

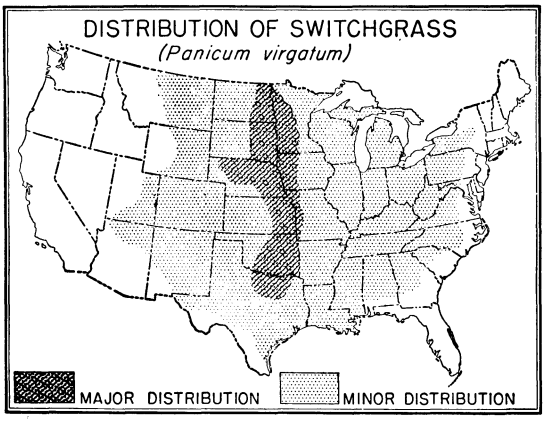
Under irrigation the set of seed has been consistently good. On dry land, however, seed heads should be examined before harvest with great care, because seed development depends upon late summer rains. Crops with less than 25 percent fill of seed are not satisfactory for

harvest. Seed ripens in late September. The seed head of lovegrass is branched, and ripening of the seed is irregular, beginning in the tip branches of each head and progressing to the lower ones.

Sand lovegrass seed has been harvested by direct combining and with binders. Combine- or thresher-run seed should have a purity of 50 percent. Cleaning with a fanning mill should result in a purity of 98 percent and a germination of 75 percent. A pound of pure seed contains about 1,300,000 seeds.

SWITCHGRASS

Switchgrass (*Panicum virgatum*) is a vigorous native perennial sod-forming grass. It grows generally throughout the region with the bluestems. It is most evident on the moist lowland soils or heavier soils having a high water table. Heavy, vigorous roots and underground stems make this species an excellent one for conservation use. It is good for protecting waterways. Seedling vigor is excellent, and good stands have been obtained easily. Switchgrass is usually seeded in mixture with the species with which it occurs naturally.



Growth begins in late spring and continues all summer. Plants often reach a height of 4 to 6 feet. Forage is produced in large quantities and is acceptable to all classes of livestock. Hay of good quality may be obtained by mowing the grass when the seed heads start to appear.

Seed matures in September in Nebraska and Kansas, and during the latter part of August in the Dakotas. The crop depends on moisture conditions and temperatures during the period of blooming and seed development. A seed fill of 50 percent is about average. Crops having less than 40 percent fill are not desirable for harvesting.

Binders and combines have been used for seed harvesting. Natural stands commonly yield more than 100 pounds of seed per acre. When the grass has been seeded in rows and cultivated, seed yields have sometimes amounted to 300 pounds per acre.

Combine- or thresher-run seed should have a purity of about 65 percent. Cleaning the seed with a fanning mill should result in a purity of 95 percent with a germination of 30 percent. Germination improves during storage and may be more than doubled if the seed is stored for a year after harvest. A pound of pure seed contains 370,000 to 420,000 seeds.

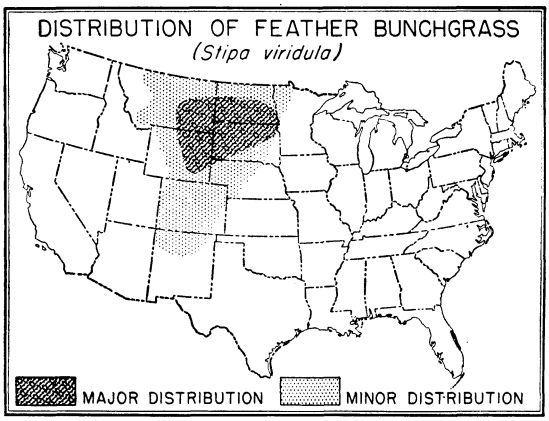
FEATHER BUNCHGRASS

Feather bunchgrass (*Stipa viridula*), known also as green needlegrass, is a native perennial bunchgrass usually found on heavy soils throughout the greater part of the northern and central Great Plains.

It grows naturally in mixture with western wheatgrass and native gramas. Growth begins early in the spring, about a week later than that of crested wheatgrass, and usually continues until midsummer. Some fall growth may be expected under favorable moisture conditions. This grass makes rapid recovery after cutting or grazing, and is well adapted for pasture use. The plants normally reach a height of 3 to 4 feet. The forage is well liked by all classes of livestock.

New plantings are readily established. Apparently feather bunchgrass is best used in mixtures with other grasses. Because the young seedlings make rapid growth and resist drought and grasshopper injury, the species has great merit for conservation use.

Seed of feather bunchgrass matures in early July in North Dakota, and earlier to the south. The crop depends on favorable moisture conditions and moderate temperatures during the blooming and seed-development stages. Seed ripening progresses from top to bottom of each seed head; thus the upper part of a seed head may shatter when the lower part is not yet ready for harvest. In order to harvest the seed when the largest amount of mature seed may be obtained, the seed heads must be examined very carefully. It is seldom possible to get more than 50 percent of the seed.



Seed of feather bunchgrass cannot be harvested satisfactorily by any method other than binding, heading, or swathing followed by threshing. Binders and headers give best results. Combines can be used, but this results in harvesting rather large amounts of immature and underripe seed.

Seed yields of 150 pounds per acre have been obtained from natural stands. When grown in rows and cultivated, this grass has yielded 300 to 500 pounds of seed per acre.

Combine- or thresher-run seed should have a purity of about 70 percent and a germination of 5 to 10 percent. Storage for a year usually increases such a germination to one of 50 to 60 percent.

Feather bunchgrass seed has light awns that make seeding with standard drills impossible. These awns can be removed readily with a hammer mill, and the seed cleaned with a fanning mill. A pound of pure seed contains from 175,000 to 190,000 seeds.

NEW INTRODUCTIONS AND IMPROVED STRAINS

Intermediate Wheatgrass

Intermediate wheatgrass (*Agropyron intermedium*) was introduced by the Department of Agriculture from the Union of Soviet Socialist Republics, and was planted first at experiment stations in the northern and central Great Plains and the Pacific Northwest.

This wheatgrass is a perennial sod-forming grass having a vigorous root system similar to those of smooth brome and western wheatgrass. It grows erect and produces a heavy growth of basal leaves. The plants vary considerably in color, texture, leafiness, and disease resistance.

Tests indicate that intermediate wheatgrass is best adapted to those areas of the region discussed here where smooth brome does best, chiefly in the eastern parts of the Dakotas and eastern and central Nebraska and Kansas. It may be used also in areas farther south and west.

The main virtues of this grass are ease of establishment and high production of excellent pasture and hay. Its large seed germinate rapidly, producing fast-growing seedlings. This tends to keep it free of root rot and seedling blight, the most serious diseases of grasses in the seedling stage.

Seed yields of from 300 to 450 pounds per acre have been harvested from cultivated row plantings. The seed crop can be harvested by direct combining, with a binder, or with a swather followed by a pick-up combine.

The South Dakota Agricultural Experiment Station has grown a considerable quantity of this grass and distributed the seed under the common name Ree wheatgrass.

Caucasian Bluestem

Caucasian bluestem (*Andropogon intermedius caucasicus*), a perennial bunchgrass, was introduced by the Department of Agriculture from the Union of Soviet Socialist Republics and has been grown at experiment stations in the central and southern Great Plains. It shows great promise as a pasture and hay grass in those areas. It is easily established from seed and makes good growth even if moisture supplies are low. The seed are small, and when they mature the seed heads shatter; therefore, seed yields are relatively low. However, seed scattered from established plants germinate readily, with the result that originally thin stands soon become more dense.

Tests of Caucasian bluestem indicate that its soil and climatic adaptation resembles that of native little bluestem, a grass to which it is decidedly superior in quality and quantity of forage. Methods of growing the grass and harvesting the seed, also, are similar to those recommended for little bluestem.

Turkestan Bluestem

Turkestan bluestem (*Andropogon ischaemum*), a perennial semiprostrate bunchgrass known in some localities as yellow bluestem, was introduced by the Department of Agriculture from India. Plantings were first made at experiment stations in the central and southern Great Plains. Results have indicated that the grass is suitable for use in these areas as a pasture and hay species. Turkestan bluestem has very leafy foliage. It appears to be similar to little bluestem in area of adaptation and use, and to excel it in quantity of forage produced. The forage is relished by all classes of livestock.

Seedlings of Turkestan bluestem are vigorous, and the grass volunteers readily. Methods of growing the grass and harvesting the seed are similar to those described for little bluestem.

Elreno Side-Oats Grama

Elreno side-oats grama (*Bouteloua curtipendula*) is an improved variety developed by the Kansas Agricultural Experiment Station and the Soil Conservation Service from plants collected near El Reno, Okla. This variety is now certified and grown by the Kansas Crop Improvement Association. It produces higher forage and seed yields than other varieties of the same species.

Methods of seed harvest are similar to those described for native side-oats grama. At the present time, however, the seed is produced chiefly in row plantings under cultivation.

Hays Buffalo Grass

Hays buffalo grass (*Buchloë dactyloides*) is an improved selection of buffalo grass developed cooperatively by the Kansas Agricultural Experiment Station and the Bureau of Plant Industry, Soils, and Agricultural Engineering. This improved variety has been approved and certified by the Kansas Crop Improvement Association. Its forage yield is very good and the plants resist leaf diseases to which most varieties of buffalo grass are susceptible. This strain is a very good seed producer, and its seedstalks grow tall enough to permit easy machine harvesting of the seed.

Hays buffalo grass does not produce much pollen. When cultivated for seed production, Hays plants are set out together with pollen-producing plants of another buffalo grass strain. Sod pieces 3 to 4 inches square are planted, 2½ to 3 feet apart. Sods of the Hays strain are used in a ratio of about 8 to 1 sod of the other strain. This predominance of seed-producing plants results in a seed yield much greater than that of natural stands of buffalo grass, in which male plants are normally as numerous as female plants.

Mandan Wild-Rye

Mandan wild-rye (*Elymus canadensis*) is an improved variety of Canada wild-rye developed at the Northern Great Plains Field Station, at Mandan, N. Dak. It is superior to ordinary Canada wild-rye in several ways; the plants are finer, shorter, and more leafy, and their leaf texture is softer. Also, they are longer lived than those of many strains and can withstand grazing over a period of several years. This variety is somewhat susceptible to rust, but is more resistant than the others that have been tested.

The main virtues of Mandan wild-rye are ease of establishment, rapid growth, and high yields of forage and seed. It can be used to great advantage in mixtures with grasses that are slower in establishment but may have higher forage quality. It recovers fairly well after cutting or grazing. In palatability it is about equal to other commonly used forage grasses, ranking somewhat lower than smooth brome or crested wheatgrass. It appears to be well adapted for use in crop rotations.

This variety was developed and released by the Bureau of Plant Industry, Soils, and Agricultural Engineering, the Soil Conservation Service, and the North Dakota Agricultural Experiment Station.

Russian Wild-Rye

Russian wild-rye (*Elymus junceus*) was introduced in 1927 from Omsk, U. S. S. R., by the Department of Agriculture, and planted at various experiment stations in the Great Plains and the Pacific Northwest. It is a large perennial bunchgrass having a deep fibrous root system. Its seedstalks are erect, and it produces an abundance of basal leaves. This species is adapted to a fairly wide range of soil types, but produces best on fertile clay loams. Successful plantings have been made throughout the northern and central Great Plains and the Prairie Provinces of Canada.

Russian wild-rye starts growth very early in the spring and continues on into midsummer, if enough moisture is available. It recovers well after cutting or grazing. In this respect and in length of growing season it outranks crested wheatgrass. It has greater merit as a pasture grass than as a hay crop. In palatability it rates below crested wheatgrass and smooth brome in early spring but equals or excels crested wheatgrass during June and July. It has value for use in grass mixtures because it extends the grazing season and gives variety to the forage.

Russian wild-rye has poor seed-producing habits, sometimes produces a weak straw, and tends to lodge. Even under cultivation it often fails to produce seed. Planting for seed production should be in cultivated rows 42 to 60 inches apart.

The seed heads of this species shatter very readily when the seed has matured. Therefore the seed must be harvested before it is fully mature, or the entire crop may be lost. A binder is recommended for harvesting, although a combine can be used.

Seed yields of from 200 to 300 pounds per acre have been harvested in favorable years. There is some evidence that still higher yields can be obtained by applying barnyard manure or nitrogen fertilizer. The seed has sharp, short awns, which make it difficult to plant with an ordinary farm drill. These can be removed with a hammer mill.

Weeping Lovegrass

Weeping lovegrass (*Eragrostis curvula*) is a perennial bunch-type grass with extensive fibrous roots, introduced from South Africa, that has proved to be well adapted to the southern Great Plains. It begins to grow early in the spring and continues all summer, often reaching a height of 4 feet. Its forage is heavy and is readily eaten by cattle during early spring. The summer growth is taken sparingly. The normal presence of green shoots in the bases of the plants often induces cattle to eat old growth during the winter.

Weeping lovegrass resists summer heat and drought, and survives winter temperatures as low as −11° F. if enough moisture is present in the soil at the time of the first killing frost.

This grass is easily established from seed. Its young seedlings are vigorous and quickly form an effective ground cover.

The seed ripens in late June, thereby escaping the hazards of the usual midsummer period of dry, hot weather. Seed ripening, like that of sand lovegrass, is irregular, progressing from the tip branches to the lower branches of each head. Seed yield per acre has amounted to 200 pounds under dry-land farming and 600 pounds under irrigation.

Binders, headers, and combines have been used in harvesting the seed. Combine- or thresher-run seed should have a purity of 50 per-

cent. Recleaning with a fanning mill should result in a seed purity of 98 percent and a germination of 85 percent. A pound of pure seed contains about 1,500,000 seeds.

Blackwell Switchgrass

Blackwell switchgrass (*Panicum virgatum*) is an improved selection developed by the Kansas Agricultural Experiment Station and the Soil Conservation Service from a plant that grew near Blackwell, Okla. Plants of this strain have more leaves and finer stems than other switchgrass. Seed yield is high, and the forage is above average in amount and in quality. Blackwell switchgrass resists leaf and stem rust, commonly found on plants of other switchgrass strains.

Methods of seed harvest are similar to those described for unimproved switchgrass.

Green Stipa Grass

Green stipa grass (*Stipa viridula*) is an improved variety of feather bunchgrass developed from a single plant at the Northern Great Plains Field Station, Mandan, N. Dak. This variety is superior to others of feather bunchgrass in general vigor and size. It recovers very rapidly after being mowed or grazed and is especially useful for seeding pastures. It grows well with other grasses, and for general farm use should be seeded in mixtures.

This improved variety was developed and released by the Bureau of Plant Industry, Soils, and Agricultural Engineering, the Soil Conservation Service, and the North Dakota Agricultural Experiment Station.

DETERMINING WHERE AND WHEN TO HARVEST

In judging whether the seed crop of a certain field of grass is worth harvesting, a seed collector must consider many things. These include among others the size and location of the field, the capacity and kind of harvesting equipment he can use, the number of seed heads and their seed content, and the demand for seed. The commercial collector makes his decision on somewhat different grounds than the "local" collector. Both types of collector must be able to recognize the best stage of seed development for harvest. Both must be prepared to complete field work quickly, so as to escape weather hazards and loss of seed through shattering.

The "local" seed collector usually harvests seed for use on his own farm only, with regular small-grain harvesting machinery. He seldom needs to clean the seed to meet commercial standards. He is most interested in small acreages of grass growing naturally or produced under cultivation usually on his own farm. Often he is justified in harvesting seed from grass stands yielding rather small quantities. Often, also, his seeding needs can be met satisfactorily by cutting mature grass, letting it cure, and scattering the hay over the field to be seeded. The commercial collector, who collects for sale at a profit, usually has the equipment needed to harvest large fields quickly, must clean the harvested seed material to meet market standards, and is most interested in fields producing high yields.

No one should attempt to decide whether a crop of forage grass seed is suitable for harvest except on the basis of actual experience in managing grass crops. However, figures 1–9 are offered as an aid in such

FIGURE 1.—Thin to medium stand of crested wheatgrass in Perkins County, northwestern South Dakota, being harvested for seed with a swather.

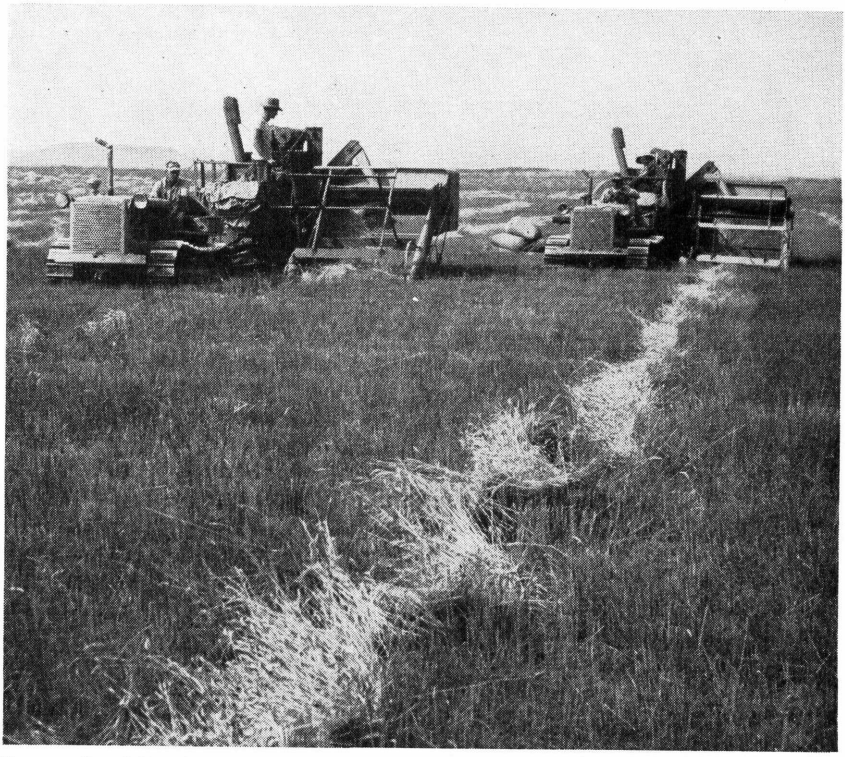


FIGURE 2.—After being cut with a windrower, this crested wheatgrass in Perkins County, S. Dak., is being harvested with small pickup combines.

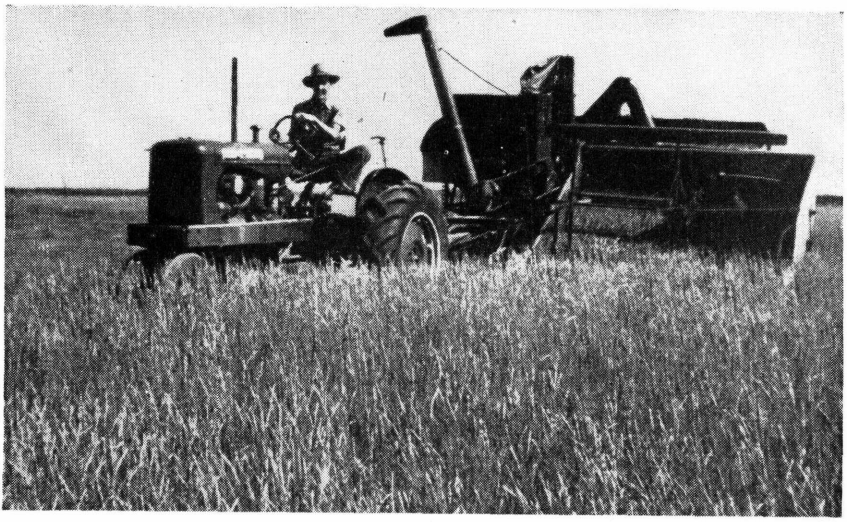


FIGURE 3.—Combine harvesting of this stand of western wheatgrass, in Scott County, Kans., produced about 132 pounds of seed per acre.

decisions. They show the thickness of grass stand usually found most satisfactory for seed harvest.

For most forage grasses the amount of plant growth and number of seed heads are similar to those of wheat. This is particularly true of western wheatgrass, slender wheatgrass, crested wheatgrass, Canada wild-rye, feather bunchgrass, and smooth brome. Big bluestem, little bluestem, sand bluestem, and switchgrass have fewer seed heads than wheat, and produce heavy, leafy basal growth.

Whether a certain stand of forage grass is suitable to be harvested for seed depends mainly on the actual amount of seed present. Abundance of seed heads is a good sign, but heads must be carefully examined to find how many seeds they contain before the stand is accepted for harvest. Typical seed heads from places selected throughout the field should be examined. In many fields plant growth and seed production are uneven. One part of a field may contain a ridge on which the soil is thin; another may contain a low swale that offers the advantage of extra moisture. Even in a field that appears to have an even stand, careful examination may show that seed is not being produced uniformly.

A collector can quickly find out whether seed are present and are mature by rubbing one or more seed heads in the palm of his hand and separating the grain, if any, from the chaff. If seed are found, this method of field sampling is recommended for all grasses discussed here except feather bunchgrass, buffalo grass, and lovegrasses:

Walk through the field, taking care to go through the poorer as well as the better parts of the stand. Every 10 steps, strip off the seed from a single seed head and place the seed in a bag or other container. Continue this until you have covered the entire field and stripped 100 or more plants.

Thoroughly mix the seed material. Count out groups of 10 seed units each. Cut through each seed unit with a knife, or pinch the base between thumbnail and forefinger so as to squeeze out the grain, if any

FIGURE 4.—This mixed stand of big bluestem, little bluestem, and switchgrass in eastern Kansas, harvested with a small combine, yielded 80 pounds of seed per acre. The operation left a stubble 32 inches high.

FIGURE 5.—Sand bluestem grown in rows on a ranch in western Oklahoma is being harvested with a small combine, set high. The height and density of its leafy basal growth are typical for the species.

is present. Count the filled and the empty seed units, and record the counts. Continue examining groups of 10 until you have made at least 100 records. Your record of filled units for the first five groups may be, for example, 4, 5, 4, 4, 3. If you find about the same numbers of filled seed units in the groups you examine later, you can safely assume that the field has a 40-percent seed fill.

At all times during a seed-harvesting operation the collector should check very carefully on the amount and quality of seed he is getting. Knowing how much seed he has harvested from a measured area enables him to forecast total yield, or to stop the operation early if yield is too low. Checking the amount and quality of seed is particularly important near the close of the harvest season, when loss of seed through shattering is likely to make machine operations unprofitable.

FIGURE 6.—Smooth brome in Pawnee County, southern Nebraska, harvested for seed with a binder.

Buffalo grass usually grows in an almost 50–50 mixture with blue grama, and only about half the buffalo grass plants are capable of producing seed. Consequently, a crop of buffalo grass seed is hardly worth harvesting unless the part of a seed-bearing plant that can be covered by a man's hand includes, on an average, 8 to 10 burs (fig. 10). To sample the seed content of buffalo grass burs, a good method is to mix well 8 to 10 burs from each of 50 to 100 well-distributed seed-producing plants, select 10 burs from the mixed lot, and cut each of these burs crosswise. Many burs will be found to contain two or more grains. The seed crop can be considered worth harvesting if 90 or more seeds are found per 100 burs examined.

Seed yield of the lovegrasses can be estimated without stripping the seed, because the outline of the grain can be seen on the unopened seed hull. Stands of these grasses, however, should be examined as thoroughly as any others. Harvesting should start when the first seed has ripened, in the tip branches of the heads. The amount of mature seed available is usually largest a few days after the tip portions of the seed heads shatter.

It is hard to outline a method for determining when seed harvest of a stand of feather bunchgrass should start. Through experience, the collector must develop judgment that will enable him to begin harvesting when the number of seeds that have matured and have not yet been lost through shattering is greatest. As a guide, it is suggested that cutting may begin when the seed in the top one-fourth to one-third of the head have turned brownish black and that part of the head has begun to shatter.

Table 1 summarizes seed-fill and related information for each of the grasses discussed here.

TABLE 1.—*Percentage seed fill, thresher-run and recleaned purity, germination, length of seed harvest, and number of seeds per pound of clean seed*

[Basis, data compiled by various Federal and State agricultural agencies]

Grass	Fill			Purity		Average germination	Length of seed harvest	Seeds per pound of pure seed
	Average	High	Minimum for harvest	Thresher-run	Recleaned			
	Percent	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Days*	*Number*
Crested wheatgrass	55	80	35	65	94	88	10–15	165,000 to 200,000.
Western wheatgrass	50	80	35	55	88	80	15–21	100,000 to 125,000.
Slender wheatgrass	70	88	35	70	95	92	10–15	140,000 to 160,000.
Big bluestem	21	70	20	24	40	60	5–25	140,000 to 170,000.
Little bluestem	35	80	30	35	55	60	5–25	254,000 to 263,000.
Sand bluestem	13	60	20	20	40	60	5–25	105,000 to 122,000.
Blue grama	29	75	25	30	45	75	1–20	800,000 to 825,000.
Side-oats grama	10	50	20	12	30	65	5–20	[1] 500,000.
Smooth brome	70	85	40	70	90	90	7–10	170,000 to 200,000.
Buffalo grass	[2] 151	[2] 250	[2] 100	65	85	[3] 50	330	[4] 40,000 to 55,000.
Canada wild-rye	75	90	40	65	94	90	15–21	110,000 to 120,000.
Sand lovegrass	40	80	25	50	98	45	5–30	1,300,000.
Switchgrass	46	5	40	50	95	[5] 45	5–20	370,000 to 420,000.
Feather bunchgrass	60	80	40	70	98	[6] 5 to 60	7–10	80,000 to 100,000.

[1] This number is obtained by processing about 125,000 seed units in a hammer mill.
[2] Number of seeds per 100 burs.
[3] Number of treated burs per 100 that produce 1 or more sprouts each.
[4] Burs.
[5] Considerable percentages of switchgrass seed produced in the central and northern Great Plains are dormant in the first year. Dormancy gradually decreases as age of the seed increases, germination reaching its maximum at from 1 to 5 years.
[6] Dormancy of feather bunchgrass seed gradually decreases as age of the seed increases, germination reaching its maximum at from 1 to 5 years.

Recognized stages of grass-seed development are milk, soft-dough, hard-dough, and vitreous. These resemble the familiar stages in the ripening of sweet corn. Grass seed harvested in the milk or the soft-dough stage are poorly developed, shriveled, and low in germination. Those harvested at the hard-dough or the vitreous stage are plump, well-developed, and usually high in germination.

FIGURE 7.—This western Kansas field of blue grama, harvested with a small combine, yielded 109 pounds of seed per acre. In order to get all the seed heads, the plants had to be cut rather low.

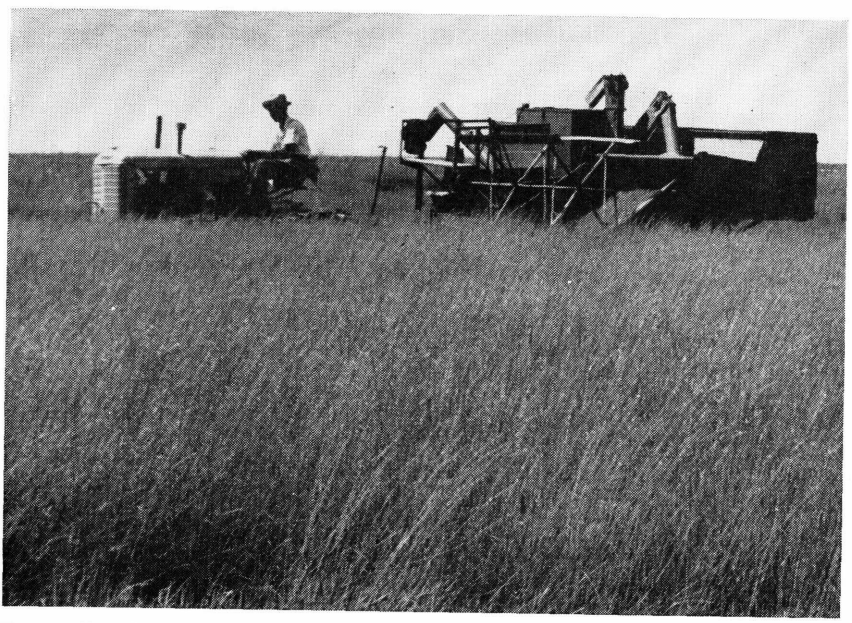


FIGURE 8.—Side-oats grama on the high plains of northern Texas being harvested with a small combine.

HARVESTING METHODS

Seeds of all the grasses discussed in this bulletin can be harvested with ordinary farm machinery (figs. 1–9). For all except buffalo grass, any machine adjustments necessary to permit good work are few and minor.

Hand stripping or heading with knife or sickle is the best harvesting method to use when only a very small amount of seed is needed, or in a field that is too small to permit use of regular harvesting machinery.

MOWER

When seed is needed only for planting a field of about 10 acres or less, mature seed hay may be cut with an ordinary farm mower, raked immediately, and stacked. During late winter or early spring the seed hay is spread evenly over the field and worked into the soil surface with a disk or packer. If equipped with a swather attachment, the farm mower can be used also to lay mature hay in windrows for pickup threshing when thoroughly cured. Because of their narrow cutting width, most farm mowers should not be used as windrowers except on small areas where cutting cannot be done with regular swathers or headers.

BINDER

Regular grain binders have been used with good success in harvesting seeds of such grasses as bluestems, switchgrass, weeping and sand lovegrass, feather bunchgrass, smooth brome, side-oats grama (in southern areas), and the wheatgrasses. When grain binders are so used the sickles should be sharp and the guards in good repair to avoid waste in cutting the grass. Bundles should be small, to permit rapid curing and prevent heating in the shock. Shocks should be small and open. In binding the grasses just listed, one shallow pan should be attached under the header platform between the platform and the elevator drapers and another under the packer mechanism to catch falling seed. The bundle carrier sometimes is not used in this operation, because its use is likely to increase shattering of seed heads.

If the bunching and tying mechanism is disconnected and only the platform draper is brought into action, a grain binder can be used effectively as a windrower or swather together with a combine equipped for pickup threshing.

The advantage of the binder in grass-seed harvest, whether used in the regular way or as a swather, is that cutting with a binder can begin several days earlier than direct combining.

WINDROWER, OR SWATHER

Standard windrowers, or swathers, move the cut material to one side and there deposit it as a continuous windrow. The windrower covers a large area rapidly. Cutting with it, as with the binder, can be started before the seed is mature enough for combining. For most grasses except feather bunchgrass, seed ripening in the field reaches a stage at which it is more economical to combine the seed direct than to continue windrowing for pickup threshing. In harvesting seed of blue grama, particularly, windrowing and pickup threshing for the early part of the harvest and direct combining for the later part have proved a desirable procedure.

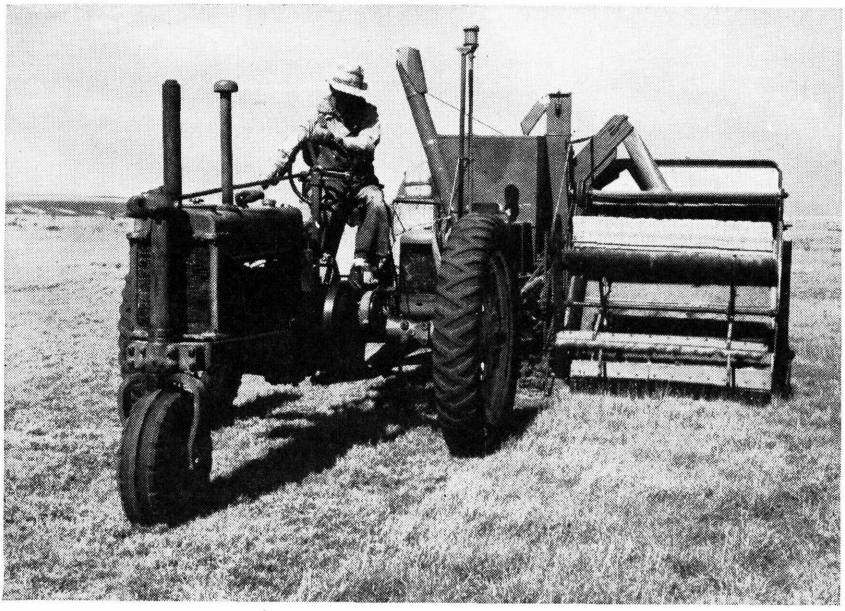


FIGURE 9.—Hitting the low spots to harvest seed of buffalo grass. Because the seed of this native grass are borne on very short stalks, the combine sickle has been adjusted to cut within about 1 inch of the ground, and special reel bats are being used.

COMBINE

Although binders, mowers, headers, and hand methods have been found desirable for grass-seed harvest under many conditions, the combine is ordinarily the best machine for the purpose except on small-scale jobs.

Combines work most effectively when seed is fully mature. If a combine is started too early, a higher percentage of undeveloped, immature, poor-quality seed is harvested. The risk of seed loss from shattering before combine harvest begins and the fact that larger seed yields may be obtained by other methods are largely offset by the lower costs of combining.

In general, combines having angle-bar or rasp-bar cylinders (fig. 11) are more satisfactory for grass-seed harvest than those having tooth cylinders. Varying the number of teeth in the tooth-and-concave type effectively reduces the chopping of straw, but usually good-quality seed is more readily obtained with the rasp-bar or angle-bar type.

To get best results in adjusting and operating a combine for harvest of grass seed, the collector needs to recognize basic differences between most grass seeds and most field-crop seeds. Weeping lovegrass, sand lovegrass, and switchgrass bear much smaller seeds than most of the common field crops, and a more vigorous threshing action is required to free their seeds. Vigorous threshing in a combine always results in a high percentage of trash in the seed material. The seeds of these grasses are easy to clean in a common fanning mill, but are too small and light to be cleaned by means of the air-blast fan in the combine.

FIGURE 10.—To find whether a crop of buffalo grass seed is worth harvesting, a seed scout parts the foliage of a seed-bearing plant and counts the burs on the portion of the plant that he can cover with one hand. They should average 8 to 10.

The seeds of the other grasses discussed here, except buffalo grass, may be as large as those of many field crops, but have a chaffy or hairy covering around the grain that makes it hard to separate them from the straw in the combine separator. However, all these seeds are readily extracted from the head by a very gentle threshing action. Use of the air-blast fan is seldom necessary in combining seed of any of these grasses; a very light blast is sometimes used on wheatgrass seed. Seeds of most grasses in this group are very hard to reclean in an ordinary fanning mill unless first processed for removal of awns and hairs. Because of this, the combine should be adjusted in such a way that it will deposit the least possible amount of leaves and broken straw in the bin or sack with the seed; the clearance between cylinder and concaves should be as wide as possible, and the cylinder speed should be the slowest that will result in complete threshing without chopping of straw or cracking of seed.

In combine harvesting of seeds of all these grasses it is best to cut fairly long straws, because long straws separate from seed more readily than short ones. Cutting straws too long, however, reduces the capacity of the machine and the number of acres harvested per day, particularly for wheatgrass. Careful adjustment of the vanes in the

chaffers aids in keeping straw out of the seed and retaining the seed of best quality. For good results an even flow of material through the combine is necessary at all times. Brushes or belting flaps should be attached to the reel bats to keep the sickle clean and avoid having "slugs" of cut material reach the combine cylinder. The best rate of forward travel should be found by increasing the tractor speed until loose seed carried out of the separator appear in the tailings, then decreasing the speed until they cease to do so. With no change in the settings, a combine can travel faster in the afternoon than in the morning, because as the day advances the material being harvested becomes dry enough to separate more readily. It is seldom possible to operate at the same forward speed as with small grain, and the tailings should be examined for grass seed frequently.

The spiral flanging of the clean-grain auger must extend into the bin elevator boot, to keep damp or light seed from clogging at that point. If there is a perforated metal screen in the bottom of the cleaning shoe of the combine it must always be removed. The lower adjustable chaffer is usually removed before harvesting seed of any grasses discussed here except the lovegrasses and switchgrass, to avoid return of too much material to the cylinder.

As grass plants become more mature or the straw becomes more brittle owing to frost, seed are more readily removed from the head and the basic cylinder settings of the combine must be changed to keep the trash content of the seed material at a minimum; the cylinder speed must be decreased or the cylinder-concave spacing increased. Careful attention to these details should result in seed material of uniform quality throughout the harvest period.

Table 2 gives suggested combine cylinder speeds and cylinder-concave clearances for each of the principal grasses discussed here. These settings are intended as a guide in starting the harvest; they will need some changes in the field. In all cases, it is important to maintain the lowest cylinder speed at which all good seed are freed from the heads, coupled with the greatest cylinder-concave spacing that does not increase the amount of finely broken stems. Chaffer vanes should be held as nearly closed as they can be and still permit the seed to fall through the openings freely.

TABLE 2.—*Combine and fanning-mill adjustments for cleaning grass seed*

Species	Combine or thresher [1]		Fanning mill	
	Cylinder speed	Cylinder-concave clearance	Upper screen size	Lower screen size
	R. p. m.	*Inches*		
Crested wheatgrass	1,400	3/8	1/16 x 1/4	6 x 30
Western wheatgrass	1,500	3/8	5/64 x 1/2	6 x 24
Slender wheatgrass	1,500	3/8	5/64 x 1/4	6 x 24
Big bluestem	900	1/2	3/16 x 1/4	1/22
Little bluestem	900	1/2	3/32 x 3/16	1/25
Sand bluestem	900	1/2	3/16 x 1/4	1/22
Blue grama	1,200	3/8	1/16	1/25
Side-oats grama	1,100	3/8	1/16 x 3/16	1/25
Smooth brome	1,000	3/8	3/64 x 5/16	6 x 30
Buffalo grass	1,400	3/8	3/16	1/25
Canada wild-rye	1,100	3/8	5/64 x 1/4	6 x 30
Sand lovegrass	1,500	1/8	1/22	36 x 36
Switchgrass	1,500	1/4	1/16	1/25
Feather bunchgrass	1,100	3/8	3/64 x 5/16	6 x 30

[1] These settings are intended as a guide in starting the harvest; they will need some changes in the field.

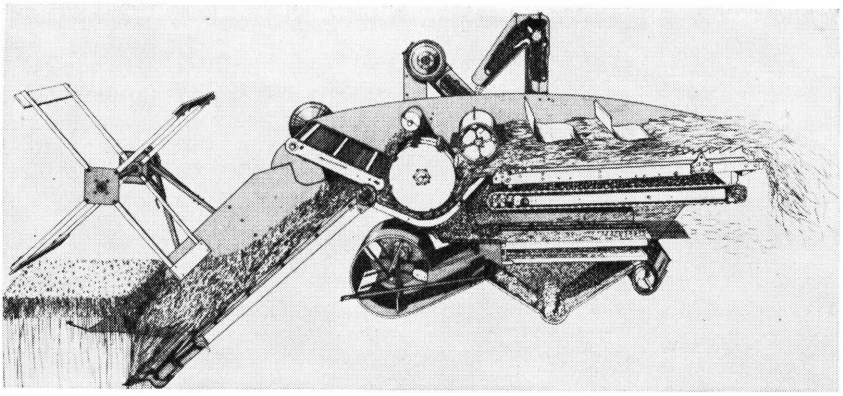


FIGURE 11.—Vertical section of combine having a rasp-bar cylinder. This type of combine is more satisfactory for grass-seed harvest than the type having a tooth-and-concave cylinder.

RELATIVE EFFICIENCY OF MACHINES

In order to throw some light on the comparative yields and costs of different types of machine harvesting of grass seed, in 1941 the Soil Conservation Service kept records on an operation covering 2,481 acres of blue grama in western Kansas, in which four comparable types of harvesting equipment were used. The results are presented in table 3.

Headers harvested seed at the lowest cost per pound and produced the highest seed yield per acre. Combines ranked next as to low cost of seed per pound but produced less than half as great a yield as headers. Such a shortage in yield is very important when only a small acreage is available for harvest. However, on large acreages an operator may be justified in sacrificing the seed that will be lost if he uses a combine. The binder compares favorably with the combine as to seed cost and produces more seed. Strippers are the least efficient type of equipment tested, producing the lowest yield at the highest cost per pound.

TABLE 3.—*Results obtained by the Soil Conservation Service with four different kinds of equipment in harvesting seed from 2,481 acres of blue grama in western Kansas in 1941*

Harvesting equipment [1]	Area harvested	Total yield	Yield per acre [2]	Area per day per machine	Field cost per pound of seed [3]
	Acres	*Pounds*	*Pounds*	*Acres*	*Cents*
Combine (5-foot)	1,530	113,852	74.4	15	0.0335
Header (12-foot)	850	150,291	176.8	30	.0235
Binder (7-foot)	31	3,960	127.7	17	.0379
Stripper (5-foot)	70	2,195	31.4	20	.0478

[1] Operated, on an average, about 10 hours per day.
[2] Purity of seed approximately equal.
[3] Costs quoted for header, binder, and stripper include that of threshing. Combines were used to thresh seed from grass cut with headers. Costs do not include those of transportation, storage, recleaning, supervision, or record keeping, which may vary greatly with local conditions. Labor cost was computed at 40 cents per hour.

The fact that seed-harvesting operations with a header or binder can be begun when the seed is too immature for direct combining counts heavily in favor of these machines in some circumstances.

A few days' lengthening of the harvest season is an advantage particularly with grasses the seeds of which ripen unevenly or the seed heads of which shatter soon after the seeds mature.

SEED CLEANING

Most grass seed requires more cleaning than it receives from a combine or thresher. Costs for cleaning range approximately from ½ cent to 3 cents per pound. They vary with the amount and kind of grass seed, the purity desired, and the amount and kinds of material to be removed. The materials that should be removed include some that are definitely harmful—for example, seed of noxious weeds. The presence of chaff, dirt, immature seed, and trash interferes with accurate determination of seeding rates and market values and with production of even stands of vigorous seedlings.

The first step in cleaning seed should be to remove excess straw. This can be done with a fanning mill having a top screen of proper size or with a home-made scalper.

GRASS-SEED SCALPER

An inexpensive home-made scalper for cleaning trashy grass-seed material is shown in figure 12. This device prepares seed for planting in drills, and in many cases prepares it for sale without further cleaning. It is especially useful in rough cleaning of seeds of bluestems, switchgrass, gramas, and buffalo grass. It can be made cheaply from scrap materials. A frame supports an inclined screen of hard-

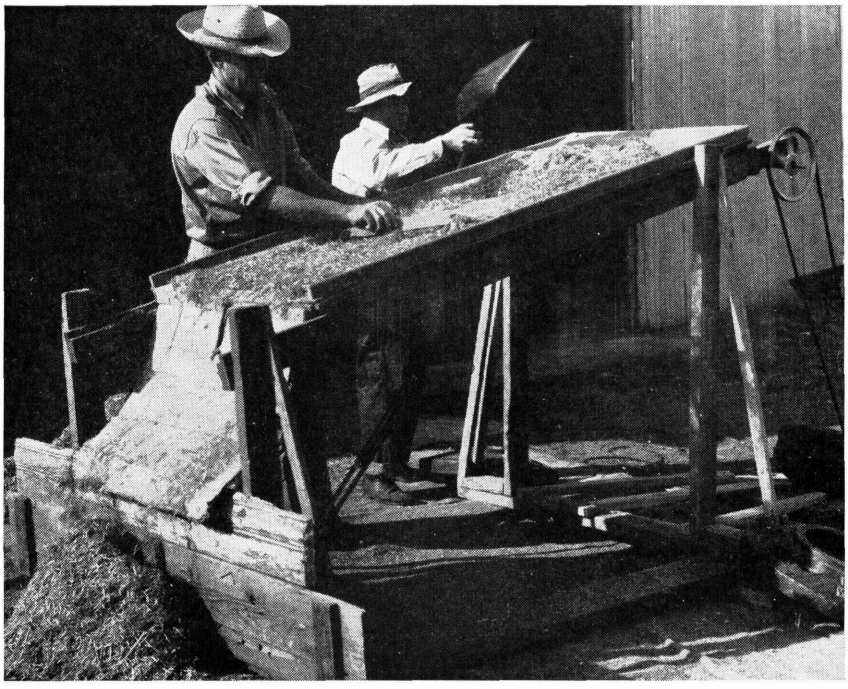


FIGURE 12.—A home-made scalper, or screener, powered by a small electric motor, is here being used to remove trash from combine-run switchgrass seed.

ware cloth, which is caused to shuttle back and forth through the action of an eccentric drive connected to a small motor. The framework need not be more than 6 feet long, and a 30-inch width is convenient for hardware-cloth screens. The screen frame should be adjustable to slopes of 6 to 12 inches. When trashy seed material is placed on the upper end of the screen the shuttling action of the frame causes the seed to fall through, while the coarse trash passes over the length of the screen. If the coarse material contains much unthreshed good seed, this may be salvaged by running the material through a thresher or combine.

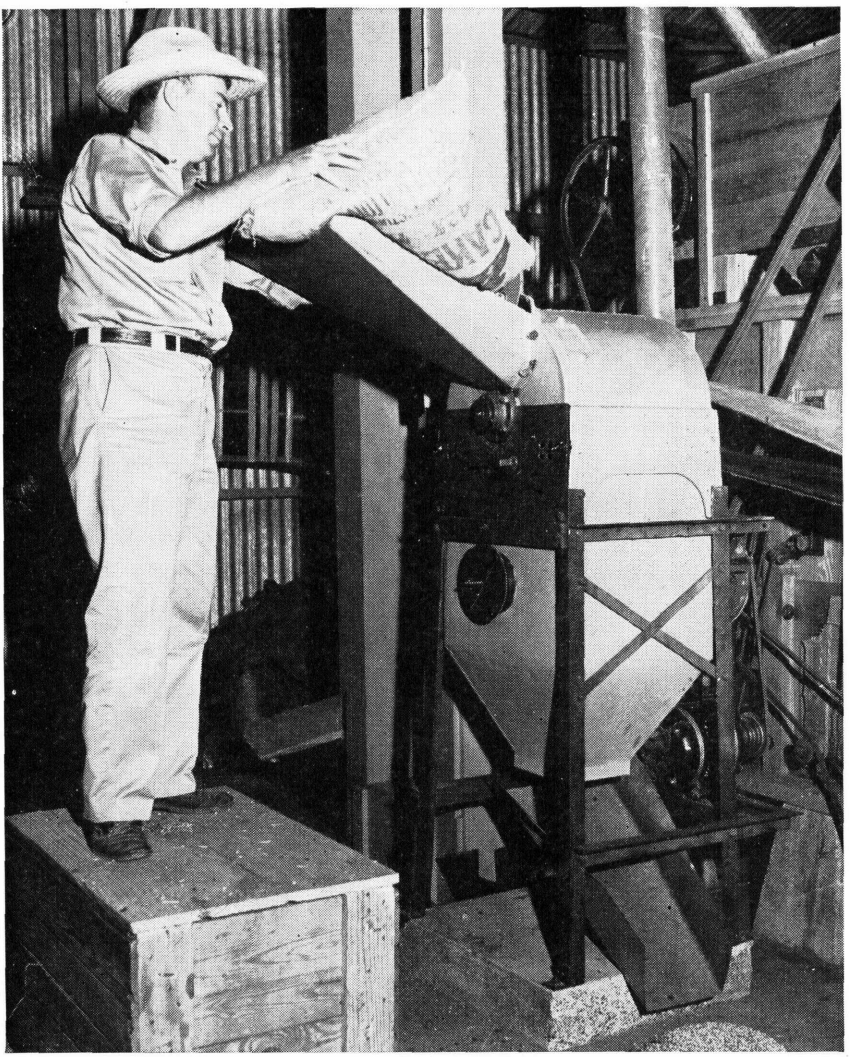


Figure 13.—The ordinary farm hammer mill serves better than any other machine for freeing many kinds of forage grass seed of awns, hairs, and other appendages that make cleaning and planting difficult and for releasing buffalo grass seed from their burs.

FANNING MILL

The ordinary farm fanning mill may be used for cleaning most grass seed, and if the work is done with care it gives excellent results. In the fanning mill, screens of different grades of fineness are used for sorting the seed, and an air blast from a fan separates the seed from the trash. By selecting screens correctly and repeating the milling process, any desired standard of seed purity can be met.

Ordinary two-screen fanning mills are used to clean seeds such as those of the lovegrasses or switchgrass and processed seeds of other species. The openings in the top screen should be just large enough to pass the largest seeds; those in the bottom screen should be of such size as to retain all good small seeds but permit sand and small weed seeds to pass through. Widely different screen sizes are necessary for efficient cleaning of seed of different grasses. Screen sizes suitable for cleaning seeds of the grasses discussed here are given in table 2.

If a fanning mill is not available locally or if large quantities of seed are to be cleaned, it may be advisable to have seed cleaning done at an elevator or a commercial seed house. The large machines used for commercial cleaning usually do a faster and more thorough job. Most of them have traveling screen brushes, roll-feed hoppers, air adjustments, variable-pitch screens, and other desirable features.

SEED PROCESSING

Many kinds of grass seed have awns and other appendages that are not ordinarily removed in threshing and that, if not removed, make it almost impossible to clean and plant the seed with ordinary farm machinery. Such appendages must be removed by mechanical treatment of the seed, referred to here as processing. Seed scarifiers are sometimes used for this purpose, but the best machine for the job is the ordinary farm hammer mill (figs. 13 and 14). When seed material has been processed in a hammer mill, it is freed of dust, broken awns, and other trash in a regular fanning mill before being planted.

With regard to seed characteristics the grasses discussed here fall into three main groups:

1. Grasses, such as weeping and sand lovegrass, the seeds of which normally are freed from their coverings by threshing and seldom require processing. Clean grain of the lovegrasses requires special drills for proper planting. The wheatgrasses are included in this class, although some lots of wheatgrass seed have pronounced awns that should be removed. Wheatgrass seed clusters or "doubles" can be broken apart by light processing.

2. Grasses the seeds of which can be prepared for planting either by complete processing, which reduces them to clean grain, or by partial processing, which removes only their undesirable appendages. Examples are the gramas, the bluestems, buffalo grass, and switchgrass. The partially processed seeds can be planted with regular farm drills, but clean grain of any of the grasses named requires special drills for proper planting.

3. Grasses the seeds of which cannot conveniently be planted in their natural condition except with specially constructed drills and broadcasters, and cannot economically be hulled, but can readily be freed of their objectionable awns by processing and then can easily be planted with ordinary farm drills. Examples are smooth brome, feather bunchgrass, and Canada wild-rye.

For processing the seed of any of these grasses, there is little or no basis for choice among the common types of hammer mill. The mills with swinging hammers (fig. 14) and those with nonswinging hammers have been used with about equal success. The results depend chiefly on speed of cylinder or rotor, size of screen openings,

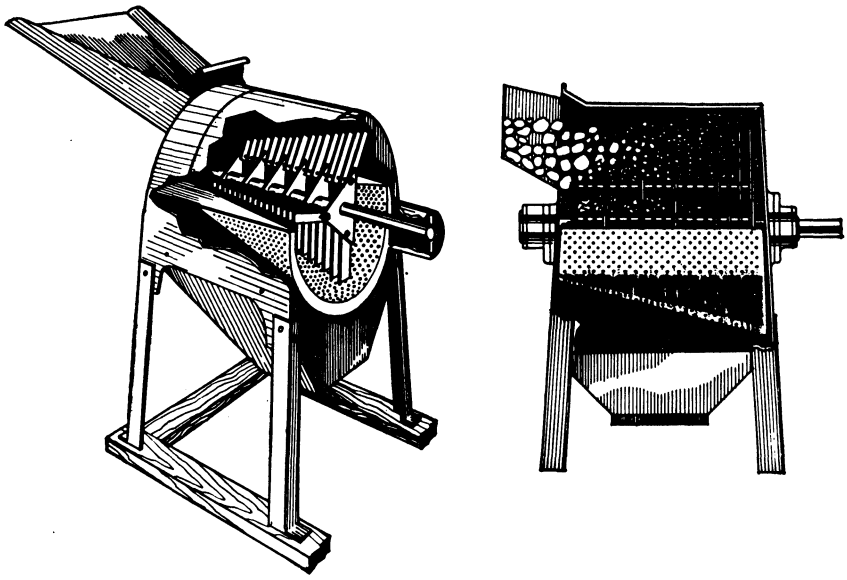


FIGURE 14.—Sectional views of ordinary farm hammer mill. About equally good results are given by the swinging hammers shown here and nonswinging hammers.

and rate of feed. These three things must be carefully determined for each grass during the milling operation.

Since farm hammer mills are designed for grinding, their normal cylinder speeds must be greatly reduced when they are used for processing seed. The correct speeds for processing seeds of the grasses under consideration here range from about 600 to 1,400 revolutions per minute. In general, the greater the length of the seeds in proportion to their thickness, the slower the cylinder speed must be to avoid much loss of seed through breakage.

Hammer-mill screens of some makes have slot openings instead of round ones. This makes possible better "fitting" of seeds to the screen openings and less breakage of long, narrow seeds. When a screen having just the right size of openings is not available, use of a coarser screen at slightly greater cylinder speed gives much the same result as would have been obtained by using a finer screen.

The hammer mill should be fed to its full capacity. Then the cylinder and hammers will roll the material around repeatedly and squeeze out through the screen whatever seeds have been trimmed enough to pass through readily. If rate of feed drops and cylinder speed remains the same, the cushioning effect of seed on the hammers is reduced and the hammers begin to perform their usual function of grinding the seed.

For adjusting the hammer mill, this procedure is recommended:

1. Place in the mill a screen having openings slightly larger than the seed to be processed.

2. Start the mill at slow speed. Fill the cylinder with seed material and keep it full.

3. After a short trial run, carefully examine the seed that has passed through the mill. If few or no cracked or hulled seeds are found but many of the seeds retain the appendages you wished to remove, advance the cylinder speed by about 100 revolutions per minute. Be very careful to prevent cracking or damaging of seed. Overprocessing may greatly reduce germination.

4. Repeat step 3 until the greatest amount of trimmed material is being obtained with least breakage of seed. Differences in seed size within a given lot often make it necessary, after running the lot through the hammer mill and cleaning it in the fanning mill, to rerun the portion still untrimmed through a finer hammer-mill screen.

Buffalo grass burs (fig. 15) are hard and nearly waterproof, and unless the burs are treated the seed do not germinate readily. The seed can easily be released by breaking down the burs with an ordinary hammer mill. Another treatment recommended is to soak the burs for 48 hours in a 0.5-percent solution of potassium nitrate, store them wet for 6 weeks at a temperature of 32° to 40° F., and then dry them quickly.

Processing rough seed material of gramas, bluestems, switchgrass, and buffalo grass is a cheap and effective way of making it easier to plant the seed accurately and efficiently. Also, when the seed has been cleaned its value can be judged more easily. An objection to cleaning grain of these grasses is that it always results in some loss of seed through breakage. Another is that with any seeding equipment now on the market the cleaned seed is planted at a somewhat wasteful rate. Also, cleaned grain cannot be stored so long as unprocessed seed of the same species.

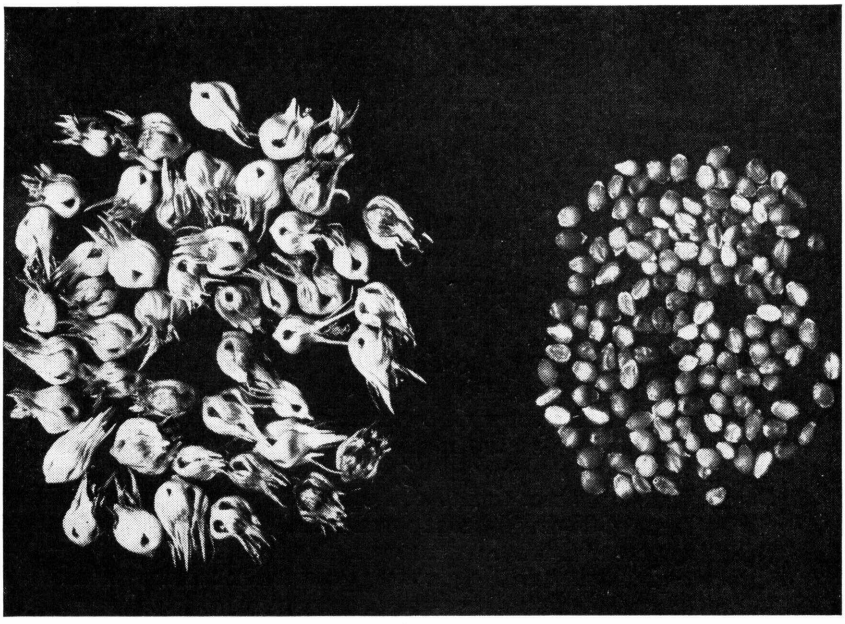


FIGURE 15.—Buffalo grass burs are hard and nearly waterproof. By use of an ordinary hammer mill it is a simple matter to break down the burs and release the seed, thus greatly improving germination.

SEED TESTING AND STORAGE

While grass seed are being cleaned, a handful or two of the cleaned seed from each bag should be kept back in a separate bag. When the cleaning is finished, the contents of this bag should be thoroughly mixed and a sample of the mix should be sent to a seed laboratory for testing. The tests should determine its purity, germination, content of weed seed and of trash, and other factors. The results measure the true value of the seed, guide the owner in setting a fair sale price, and enable the user to plant the right amount of seed per acre. To be of most value to the seed user the seed tests, especially the test of germination, should be made shortly before the seed is used.

Seed purity and germination averages for the grasses discussed here are given in table 1. These values, based on large numbers of seed samples, may be used as a guide in buying seed of these grasses or in offering such seed for sale.

Freshly harvested seeds of many of the native grasss, especially western wheatgrass, feather bunchgrass, switchgrass, and the bluestems, usually are dormant; that is, even if they are plump, appear to be mature and sound, and have every sign of good quality, they do not germinate well. Usually these seeds must be stored for a period, sometimes a year or more, before they will make their highest germination. It is recommended, therefore, that all seeds of the grasses just listed be stored for at least one season before being planted.

Grass seed should dry before it is bagged or placed in bins for storage. If it is damp or some of it is undeveloped and immature, as is often the case with seed obtained by direct combining, it should be spread out thinly for drying. Seed keeps best in a cool, dry room, and should be protected from rodent or insect damage. For protection against rats and mice, seed may be stored in a steel bin or in a wooden structure lined with heavy screens. If this cannot be done, the seed should be stacked in such a way that open space is left between the tiers of sacks and the walls of the storage room.

ASSISTANCE THROUGH SOIL CONSERVATION DISTRICTS

A farmer or rancher who undertakes to harvest grass seed is likely to need personal assistance from an experienced technician. Such assistance may be obtained from several agricultural agencies. Technicians of the Soil Conservation Service provide it to farmers and ranchers within areas that have been organized as soil conservation districts. More than 400 soil conservation districts have been organized in the region discussed here.

Conservation district supervisors usually arrange for technical assistance to district cooperators in judging whether stands of grass are suitable for seed harvest and in adjusting farmer-owned harvesting equipment. Also, district-owned equipment for harvesting, cleaning, and processing seed is usually made available. District organizations have greatly increased the collecting of grass seed and have aroused wide interest among farmers in growing grasses for conservation of soil and water and for additional income.

Many farmer cooperators of soil conservation districts are now producing seed of superior forage grass strains under cultivation, with district supervision. Their seed-increase work meets the field stand-

ards developed by State seed-certifying agencies. It is the best known means of rapidly increasing seed of superior forage grasses for commercial use.

As farmers in the region discussed here learn more about methods of grass-seed production and harvest and make greater use of equipment for seed harvesting, processing, and cleaning provided by conservation districts, seeds of grasses important to the region will become more readily available, locally and commercially.

Increased seed production and collection by district communities have another great merit: when a farmer plants seed grown on his own land or on land nearby that is closely similar to it, he knows that the seed is of a strain suited to the climatic and soil conditions of the planting site.

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